MOTOROLA
test equipment

AUDIO OSCILLATOR
20-200 KHz

S1067 SERIES

MP MASTER
MA36331

68P81043A40-D

AUDIO OSCILLATOR

MODELS S1067A
AND S1067B

SPECIFICATIONS

FREQUENCY RANGE	20 Hz-200 kHz, in 4 overlapping ranges.
DIAL ACCURACY	± 5%
FREQUENCY RESPONSE	± 1 dB into 150 ohms or more (resistive load).
OUTPUT VOLTAGE	1.5 V rms ± 1 dB into 150 ohms 1.0 V rms (min.) into 50 ohms
SOURCE IMPEDANCE	Less than 50 ohms at any output voltage level.
DISTORTION*	Less than 1.0%
TRANSISTOR COMPLEMENT	One silicon field effect transistor and six silicon transistors.
BATTERY LIFE AND TYPE**	100 hours: 600 ohms or higher loads 80 hours: 150 ohms 50 hours: 50 ohms Battery: 1 Burgess type 4156 (22-1/2 V) dry cell or equivalent.
AC INPUT REQUIREMENTS	105-130 V ac, 50 Hz-400 Hz at 6 mA approximately. Can be operated from 230 V ac, 50-400 Hz by using optional SKN6009A 230/117 V AC Adapter Cable Kit
FILTER (1 kHz DISTORTION ANALYZER) CHARACTERISTICS	frequency accuracy = ± 5% 1 kHz rejection = more than 50 dB input resistance = 600 ohms (approx.)
OPERATING TEMPERATURE	0° to + 50°C (32°F to 122°F)
DIMENSIONS	10-1/4'' x 6-1/2'' x 5-3/4'' (approx.)
WEIGHT	7-3/4 pounds

SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE

*For 50 Hz to 200 kHz with 150 ohm or higher load at 1.5 V rms maximum, and 50 ohm load at 1 V rms maximum.
**Based on discharge time of 4 hours per day at room temperature.

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Communications Division

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1. INTRODUCTION

1.1 The Models S1067A and S1067B Audio Oscillators are transistorized, compact, lightweight units that provide laboratory-quality performance. The circuit construction assures high reliability and accuracy with a minimum of maintenance. The audio oscillator is ideally suited for the maintenance of "Private-Line", "Quik-Call", single-tone, and similar tone-operated two-way radio equipment. It can also be used to check the frequency response of audio amplifiers.

1.2 The unit includes 1 kHz distortion analyzer that is used with a Motorola AC Voltmeter (or equivalent) to simplify and reduce the time required to check the distortion level in receiver audio circuits and amplifiers. This feature is used when making EIA SINAD receiver sensitivity and quieting checks.

1.3 The unit will operate equally well from a 117 V ac, 60 Hz power source or from its self-contained 22-1/2-volt battery. Battery life is more than 100 hours at a 600- ohm or higher load. Refer to the performance specifications for other battery life values. When operated from a 117 V ac power source, a detachable shielded power cord is used. This cord includes a short-circuit-proof transformer molded into the larger plug housing that reduces the input voltage to 12 V rms. The 12 V rms is fed to the audio oscillator power supply via the shielded cord, thereby minimizing the danger of electric shock and hum pickup normally encountered in conventional 117 V ac power supplies.

1.4 The unit will also operate from a 230 V ac, 50-400 Hz, power source when the optional Model SKN6009A (230/117 V AC) Adapter Cable Kit is used. This adapter cable must be ordered, separately.

2. MODEL COMPLEMENT

The Model S1067B Audio Oscillator consists of the following items.

-- SLN6211B Audio Oscillator
-- SKN6010A Power Cable Kit
-- SLN6212A Battery Kit

The Model S1067A is directly interchangeable with the Model S1067B. All references to the Model S1067B in these instructions is fully applicable to the Model S1067A.

3. ACCESSORY ITEMS

The following accessory items are available for use with the audio oscillator.

3.1 SKN6009A (230/117 V AC) ADAPTER CABLE KIT

3.1.1 This cable kit is an optional accessory item that reduces a 230 V ac power source to 117 V ac. It is used with the SKN6010A Power Cable Kit supplied with the Model S1067B Audio Oscillator which reduces 117 V ac to 12 V rms. One end of the SKN6009A Adapter Cable mates with the potted transformer end of the SKN6010A Cable Kit.

3.1.2 The SKN6009A Adapter Cable consists of approximately six feet of three conductor cable, a small cylindrical housing containing a potted step-down transformer and a three pin connector that mates with the plug on the transformer end of the SKN6010A Power Cable Kit. An ac line plug is not provided since 230 V ac source power receptacles are not standardized. When connecting the ac line plug, connect the BLK and WHT leads to the 230 V ac line terminals of the plug and the GREN lead to ground.

3.2 SLN6214A MATCHING TRANSFORMER KIT

3.2.1 This kit is used to step up the audio oscillator output voltage to approximately 10 V rms. The voltage step up is necessary when it is required to audio modulate an FM signal generator that has an external modulation input impedance of approximately 10 k-ohms at 1 kHz.

3.2.2 The transformer is housed in a miniature phenolic box. It has a double banana plug that is inserted into the OUTPUT terminals of the audio oscillator and a dual banana jack for connecting a cable to the FM signal generator or other circuitry. Refer to Figure 2 for a typical transformer hookup.

4. PREPARATION FOR USE

To operate the Model S1067B Audio Oscillator, remove the front cover and proceed as follows:

4.1 BATTERY INSTALLATION

Step 1. Loosen the four captive screws in the back housing panel and separate the housing from the audio oscillator.

Step 2. Loosen the captive screw holding the battery mounting clamp to the housing and remove the clamp.

Step 3. Insert the battery in the housing with its positive (+) terminal to the left and replace the mounting clamp.

Step 4. Connect the unterminated RED and BLK leads to the battery. OBSERVE POLARITY -- red lead to the battery positive (+) terminal, black lead to the negative (-) terminal. To the battery positive (+) ter-

minal also connect the short RED lead from the battery test jack on the back of the instrument housing.

Step 5. Replace the instrument housing.

4.2 OPERATING POWER

Step 1. If the unit is to operate on its self-contained battery, turn the RANGE switch until the word BATT can be read right side up. To turn on the audio oscillator, turn the OFF-AMPLITUDE control clockwise until a" click" is heard.

Step 2. If the unit is to operate from a 117 V ac power source, mate the power receptacles of the SKN6010A Power Cable Kit to the audio oscillator and the 117 V ac power source receptacle. Turn the RANGE switch until the word LINE on the knob can be read right side up. To turn on the audio oscillator, turn the OFF-AMPLITUDE control clockwise until a "click" is heard.

The ac power supply uses a voltage doubler and RC filter network in providing the operating voltage for the audio oscillator. Its input power is obtained from a 117 V ac, 60 Hz source through the shielded SKN6010A Power Cable Kit.

NOTE

To completely isolate the audio oscillator from the ac line and possible hum pickup, it should be operated from its self- contained battery. The SKN6010A Power Cable Kit should be disconnected from the unit.

Step 3. When the unit is not in use, the RANGE switch should be placed in the LINE position. In this position, the battery is disconnected, thereby preventing its discharge if the oscillator is inadvertently let on or accidentally turned on.

5. USE OF OPERATOR'S ITEMS

5.1 FREQUENCY SELECTION

Frequency selection is achieved by selecting the multiplier range with the RANGE switch and adjusting to the desired frequency with the FREQUENCY control dial.

The RANGE switch is used to select the FREQUENCY dial setting multiplier range. It is divided into four ranges: x1, x10, x100 and x1K; each of which when multiplied with the FREQUENCY select dial setting indicates the frequency output of the audio oscillator. The same setting on the FREQUENCY select dial provides four different output frequencies depending upon the RANGE switch setting. For example, a setting of 20 on the FREQUENCY select dial provides the following output frequencies through the four RANGE switch settings:

x1 = 20 Hz
x10 = 200 Hz
x100 = 2,000 Hz
x1K = 20 kHz

The small control knob that slightly overlaps the FREQUENCY select dial, on the lower right side, is used as a fine adjustment control to more closely adjust for the desired output frequency.

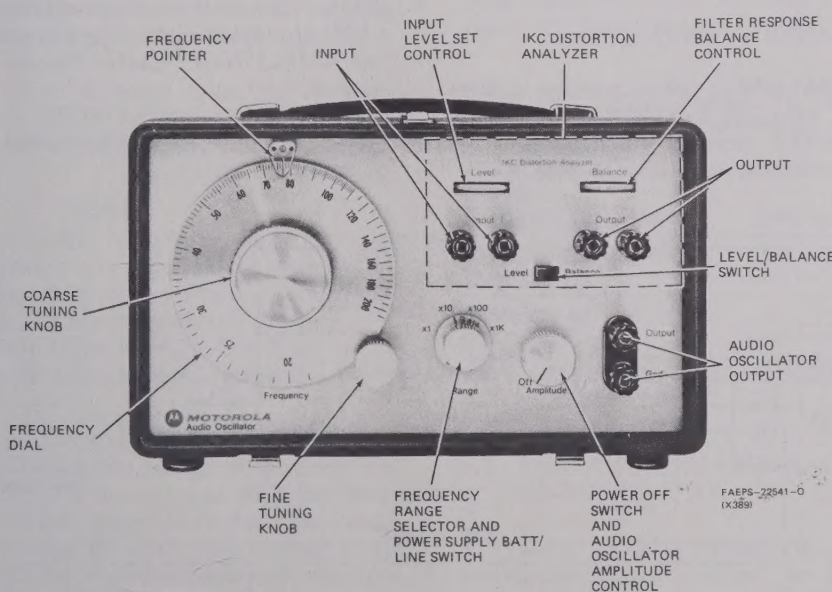


Figure 1. Location of Operator's Items (For Description and Use, See Text)

5.2 AMPLITUDE ADJUSTMENT

In addition to its function as the power on-off switch, the AMPLITUDE control also adjusts the output signal level.

5.3 OSCILLATOR OUTPUT

The audio oscillator output is brought out to the OUTPUT-GND dual-binding posts, located to the right of the AMPLITUDE control. Connections to these posts are made with a mating double-banana plug, tipped plugs, spade lugs, alligator clips or bare wire.

5.4 INPUT TERMINALS

The INPUT terminals to the 1 kHz DISTORTION ANALYZER are located directly below the LEVEL control.

5.5 LEVEL CONTROL

The LEVEL control is used for setting a reference voltage for the 1 kHz DISTORTION ANALYZER.

5.6 BALACE CONTROL

The BALANCE control adjusts the shape of the 1 kHz DISTORTION ANALYZER filter response curve.

5.7 OUTPUT TERMINALS

These OUTPUT terminals from the 1 kHz DISTORTION ANALYZER are located directly below the BALANCE control (do not confuse with the oscillator OUTPUT terminals).

5.8 LEVEL/BALANCE SWITCH

The LEVEL/BALANCE switch provides a short circuit across the 1 kHz DISTORTION ANALYZER filter when in the LEVEL position. When placed in the BALANCE position the short circuit is removed.

Step 4. Set the RANGE switch to the proper multiplier range for the desired frequency output.

Step 5. Adjust the AMPLITUDE control for desired signal level output.

Step 6. Connect the output to the unit under test through the OUTPUT-GND binding posts (next to the AMPLITUDE control).

Step 7. Steps 3 and 5 might have to be repeated due to frequency stabilization and output loading.

NOTE

To avoid possible rf pickup through the oscillator housing, keep the unit as far from high power transmitters as possible.

6. OPERATING INSTRUCTIONS

6.1 HOW TO USE AUDIO OSCILLATOR

Step 1. Set up the unit for operation from the desired power source, ac line or internal battery, as described in paragraph 4.2.

Step 2. Turn on the unit by rotating the AMPLITUDE control clockwise until a "click" is heard. Allow at least 10 seconds for capacitor charging and frequency stabilization.

Step 3. Set the FREQUENCY control to the desired setting.

6.2 HOW TO USE 1 kHz DISTORTION ANALYZER

Step 1. Set up the audio oscillator for a frequency of 1 kHz as previously described in paragraph 6.1. Adjust the AMPLITUDE control for minimum signal level output.

Step 2. Connect the audio oscillator to the amplifier as shown in Figure 2.

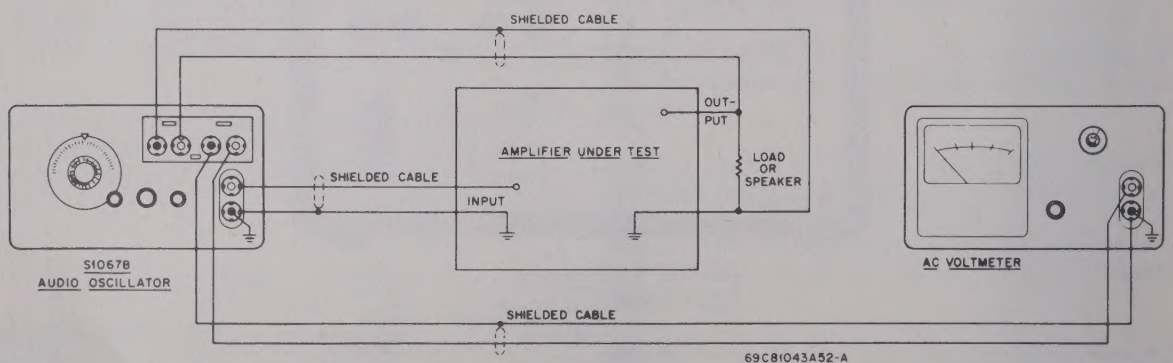


Figure 2. Interconnection Block Diagram for Distortion Testing

Step 3. If the output power of the device being tested is not known, do steps 4-6. Otherwise, proceed to step 7.

Step 4. Connect the output of the device to a loudspeaker, or a load resistor of proper resistance and suitable power handling capability. Connect the Motorola S1053 AC Voltmeter, or equivalent, across this load.

Step 5. Slowly increase the output of the audio oscillator by rotating the AMPLITUDE control clockwise. While watching the AC voltmeter, continue increasing the audio oscillator output until the output voltage doesn't increase anymore, and *you can still increase* the audio oscillator output, back down (counterclockwise) on the amplitude control until the meter moves down scale. The voltage read when it just starts to move is related to the maximum power output.

Step 6. Calculate the output power using the formula $P = V^2/R$.

Where: V is in volts
R is in ohms.

EXAMPLE — Assume that the amplifier is working into a 3.2 ohm speaker and the ac voltmeter reading is 4 V rms. Solve for P as follows:

$$P = (4)^2/3.2 = 16/3.2 = 5 \text{ watts}$$

Set the AMPLITUDE control to minimum output.

Step 7. If the output power of the device being tested is known, connect its output to a suitable load (loudspeaker or resistive). To avoid possible rf pickup through the oscillator housing, keep the unit as far from high power transmitters as possible.

Step 8. Connect the ac voltmeter to the OUTPUT terminals of the 1 kHz DISTORTION ANALYZER. BE CAREFUL TO OBSERVE POLARITY.

NOTE

The Motorola AC Voltmeter and the Audio Oscillator are grounded to their respective housings and not to ac line ground. The common terminal of the 1 kHz DISTORTION ANALYZER is not grounded to the audio oscillator housing.

Step 9. Place the LEVEL-BALANCE switch in the LEVEL position. If the output voltage of the device under test is more than 10 V but less than 50 V, set the ac voltmeter in the 10-volt range and adjust the audio oscillator LEVEL control for a full scale reading. If the output voltage of the device under test is more than 1 V but less than 10 V, set the ac voltmeter in the 1-volt range and adjust the LEVEL control for a full scale reading.

NOTE

Use only the 10-volt or 1-volt range for setting the LEVEL control in distortion measurements. These levels are used for calculating the full scale meter reading for 100% distortion.

Step 10. Place the LEVEL-BALANCE switch in the BALANCE position. Adjust the BALANCE control to obtain a dip or minimum reading on the ac voltmeter. This adjustment should be made on a mid-scale meter reading. Change the ac voltmeter full scale range accordingly.

Step 11. Slowly turn the FREQUENCY dial fine-adjust control to obtain a dip or minimum reading on the ac voltmeter. This adjustment should also be a mid-scale meter reading.

Step 12. Repeat Steps 10 and 11.

Step 13. Where greater distortion accuracy is required, or a low distortion figure (approximately 1%) is expected, repeat Steps 10 and 11 again.

Step 14. Distortion percentage is read on the ac voltmeter in terms of a full scale reference. If for example, after completing Step 12 or 13, the reading on the ac voltmeter is 3.5 volts using the 10-volt full scale range, the 10-volt full scale range represents 100% distortion. The 3.5 V reading, therefore, represents 35% distortion.

If the distortion figure is 30% or less, change the full scale meter range from 10-volts to a smaller scale, such as 3 volts. This range represents 30% distortion at full scale. A 1 V reading on this scale represents 10% distortion. Refer to Table 2 for other voltage to distortion percentage equivalents.

Table 2. Voltage Reading To Distortion Percentage Equivalents

Percent Distortion	100%	30%	10%	3%	1%
Reading on 10 V Scale	10 V*	3 V	1 V	.3 V	.1 V
Reading on 1 V Scale	1 V*	.3 V	.1V	.03 V	.01 V

*Full scale reading for meter calibration.

6.3 HOW TO MAKE AN EIA SINAD SENSITIVITY MEASUREMENT

Since the EIA SINAD sensitivity and quieting measurements are specified for most two-way radio equipment, the set-up and test procedure using the Model S1067B Audio Oscillator and related test equipment is outlined herein. Refer to Figure 3 for a typical

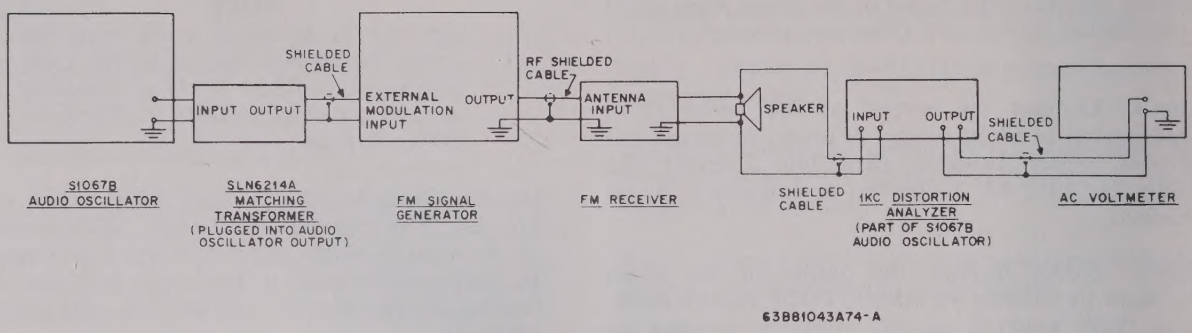


Figure 3. EIA SINAD Receiver Sensitivity Measurement Test Set-Up

test set-up in making an EIA SINAD receiver sensitivity measurement.

To make an EIA SINAD receiver sensitivity measurement, the following Motorola test equipment (or equivalent) is required:

-- Model S1067B Audio Oscillator
-- Model SLN6214A Matching Transformer
-- Model T1034C, T1035C or T1036A, S1318A, S1319A, S1320A, S1321A or S1329A FM Signal Generator
-- Model S1053 Series AC Voltmeter.

Step 1. Connect the test equipment to the receiver as indicated in Figure 3.

To avoid possible rf pickup through the oscillator housing, keep the instrument as far from high power transmitters as possible.

Step 2. Turn on all test equipment and apply power to the receiver under test.

Step 3. Adjust the OFF-AMPLITUDE control on the audio oscillator for minimum output.

Step 4. Set the FM signal generator to the receiver frequency and its output to 1000 uV.

Step 5. Set the audio oscillator output frequency to 1 kHz. Adjust the OFF-AMPLITUDE control for a deviation reading on the FM signal generator of 2/3 of the maximum rated receiver deviation.

Step 6. Adjust the receiver volume control to obtain the rated audio output. The ac voltmeter can be used to measure the audio output voltage if the power output rating and speaker impedance are known by using the formula $V = PR$. For example, if the audio output rating is 5 watts and the speaker impedance is 3.2 ohms, then $V\,(rms) = 5 \times 3.2 = 16 = 4$ V.

Step 7. Place the LEVEL-BALANCE switch on the audio oscillator in the LEVEL position. Adjust the LEVEL control for an ac voltmeter reading of 1 V full scale.

Step 8. Place the LEVEL-BALANCE switch in the BALANCE position. Adjust the BALANCE control for a dip or minimum reading on the ac voltmeter. Use the meter scale that will provide a mid-scale reading.

Step 9. Adjust the audio oscillator fine-frequency adjust control to obtain a dip or minimum reading on the ac voltmeter.

Step 10. Repeat Steps 8 and 9.

Step 11. DO NOT disturb the BALANCE control setting or the audio frequency setting after completing Step 10. The ac voltmeter reading obtained in Step 10 is the receiver distortion level in percentage. This figure is not used for the sensitivity measurement, however, the control settings to obtain this figure are used.

Step 12. Set the ac voltmeter to its 1-volt full scale range. Place the LEVEL-BALANCE switch in the LEVEL position. Note the ac voltmeter reading in dB (+2.3 dB is equal to 1 V).

Step 13. Reduce the output level of the FM signal generator so that the difference in ac voltmeter readings between those obtained in the LEVEL and BALANCE switch positions is 12 dB. (Generator output reduced to be approximately equal to 12 dB of the SINAD sensitivity of the receiver.) This function is represented by the expression:

$$\frac{\text{LEVEL}}{\text{BALANCE}} = \frac{\text{Signal + Noise + Distortion}}{\text{Noise + Distortion}} = 12\ \text{dB}$$

NOTE

To more quickly obtain results, use one hand to adjust the signal level of the FM generator and the other hand to switch back and forth between the LEVEL and BALANCE switch positions.

Step 14. Read the FM signal generator output level in microvolts. At this input level, if the receiver output level is 50% of the rated audio output without readjustment of the receiver volume control (set in Step 6), the rf input level is the EIA 12 dB SINAD receiver sensitivity. If the audio output is less than 50% of the rated audio output, increase the FM signal generator output level until 50% of full rated audio output is obtained. This level is the EIA 12 dB SINAD receiver sensitivity.

7. CIRCUIT DESCRIPTION

7.1 INTRODUCTION

The Model S1067B Audio Oscillator is an overlapping four range unit providing output frequencies from 20 Hz to 200 kHz. Its circuitry consists of a Wien bridge network, an oscillator-amplifier, a push-pull output stage, a 1 kHz filter, and a power supply. Refer to the schematic diagram in the rear of these instructions.

7.2 WIEN BRIDGE NETWORK

The Wien bridge network basically consists of variable capacitors Ca-Cb and resistors Ra - Rb. Ca-Cb, Ra-Rb are used in this instance for explanatory purposes only (see Figure 3), and are not for referencing as shown on the schematic diagram. These components are used as the frequency selection element in the positive feedback path. Thermistor RT-1 and resistor Rx are connected into the negative feedback path. These components provide constant output voltage amplitude across the audio oscillator frequency band. The use of negative feedback also minimizes internal distortion (see Figure 5) and provides extremely high stability, independent of transistor characteristics or voltages. The output of the Wien bridge has maximum voltage and zero phase shift at the resonant frequency which is the frequency of oscillation. The resonant frequency (fo) is expressed by the formula:

$$f_o = \frac{1}{2\pi RC}$$

When: $R_a = R_b$

$$C_a = C_b$$

Ganged capacitors Ca-Cb (equal in value) are used as the frequency tuning elements. Resistors Ra-Rb are equal in value. A different set of these resistors is used in each of the four frequency multiplier ranges.

7.3 OSCILLATOR-AMPLIFIER

The oscillator-amplifier consists of transistor Q1, a common source field effect amplifier, followed by Q2, a direct coupled emitter-follower stage. Q1 has an extremely high input impedance due to its field effect characteristics and the negative voltage feedback. Q2 matches the high load impedance of Q1 to the low input impedance of Q3, a common emitter amplifier. Q3 drives push-pull emitter-follower transistor pair Q4 and Q5. The audio oscillator feedback voltage is obtained from the output of Q4 and Q5. It is fed to the input of Q1 through the Wien bridge network. The positive feedback voltage is fed through the RC network. The negative feedback voltage is fed through the thermistor-resistor network.

The audio oscillator amplitude control is connected between the oscillator-amplifier output and the push-pull output stage. It adjusts the oscillator-amplifier output voltage linearly at any voltage level setting.

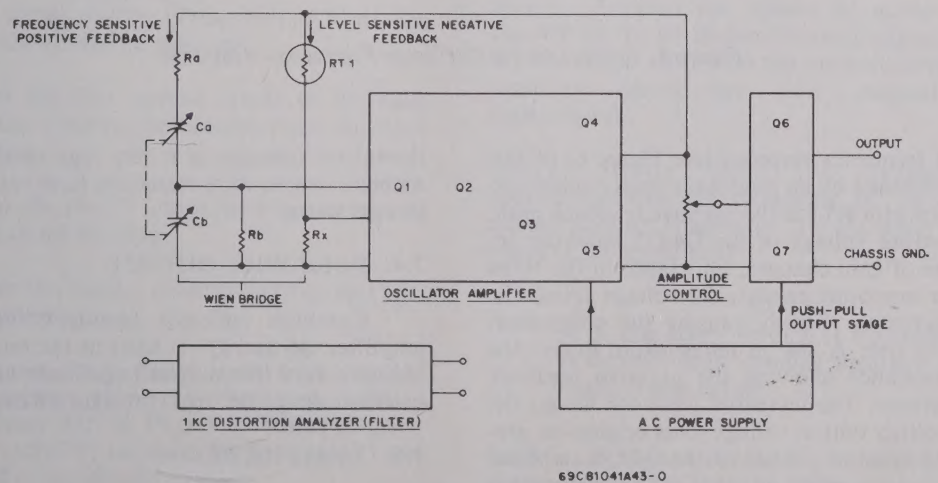


Figure 4. Functional Block Diagram

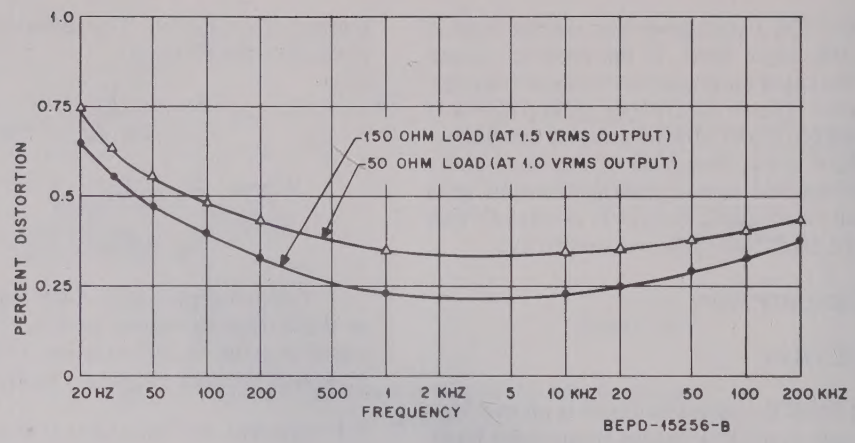


Figure 5. Typical Audio Oscillator Distortion Versus Frequency

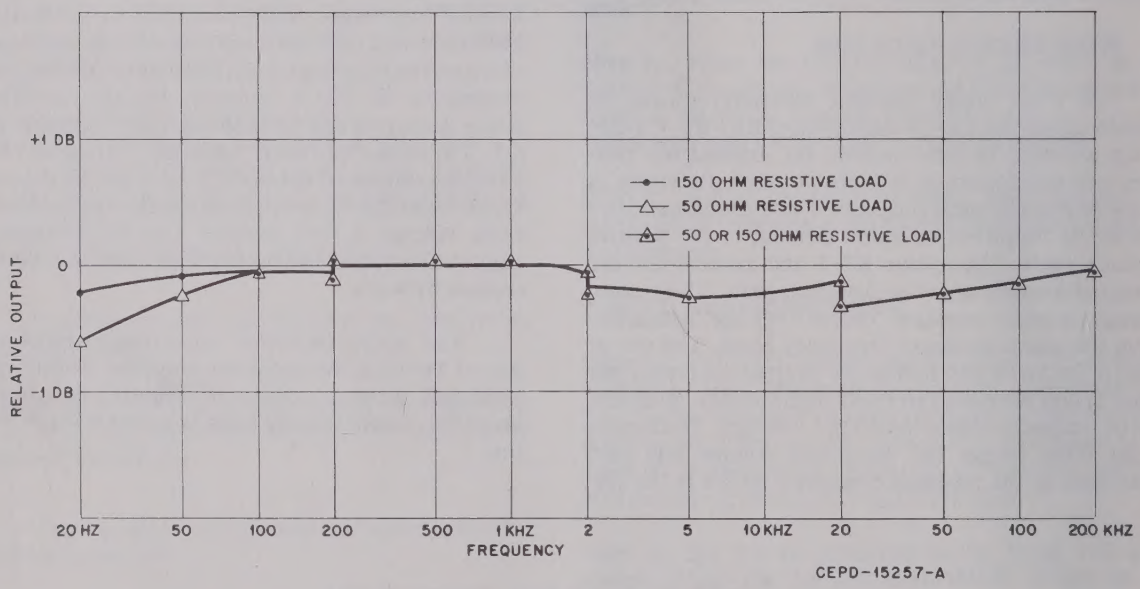


Figure 6. Typical Audio Oscillator Frequency Response

The flat frequency response (see Figure 6) of this oscillator is obtained by an automatic level control circuit using thermistor RT1 in the negative feedback path. Should the output voltage of the Q4-Q5 amplifier increase because of gain changes, unbalance in the Wien bridge, or for any other reason, the voltage across the thermistor increases, thereby causing the component temperature to rise. A rise in temperature lowers the thermistor resistance allowing the negative feedback voltage to increase. The increased feedback lowers the oscillator-amplifier output voltage to its original or proper level. If the output voltage of the Q4-Q5 amplifier decreases, the reverse effect on the RT1 thermistor takes place, thereby causing the opposite condition to re-establish the original output voltage level. Normally, the thermistor operates at a very high temperature so that ambient temperature variations have very little effect on its operation.

7.4 PUSH-PULL OUTPUT

Common collector (emitter-follower) push-pull amplifier Q6 and Q7 is used in the output stage, providing a very low output impedance and isolating the oscillator-amplifier from the load (circuit under test).

7.5 1 kHz FILTER

The 1 kHz filter is used in making distortion measurements. It consists of a bridge "T" circuit that

rejects the 1 kHz tone component and passes all remaining frequencies. A high "Q" audio choke and mylar capacitors form a tuned circuit that provides filter rejection of more than 50 dB. When the LEVEL-BALANCE switch is placed in the LEVEL position, the choke is shorted out, thereby allowing all frequencies to pass. At this point in a distortion measurement, the LEVEL control is adjusted so that the filter output provides a full scale reading on the ac voltmeter. When the LEVEL-BALANCE switch is placed in the BALANCE position, the short across the high "Q" choke is removed. At this point, the amplitude of the 1 kHz rejection (steepness of filter curve) is adjusted by using the BALANCE control.

Being a passive network, the 1 kHz distortion analyzer filter does not require power from the power supply. It is independent of the oscillator circuitry.

7.6 POWER SUPPLY

The power supply uses a voltage doubler and RC filter network in providing the operating voltage for the audio oscillator. Its input power is obtained from a 117 V ac, 60 Hz source through the shielded SKN6010A Power Cable Kit.

8. BATTERY TEST AND REPLACEMENT

Step 1. To determine the need for battery replacement, insert the positive probe of a Motorola DC Multimeter into the battery test jack on the back of the housing. Connect the ground lead to the GND binding post.

Step 2. Turn on the audio oscillator and increase the amplitude to maximum.

Step 3. The dc voltmeter should not read less than 15 V dc.

Step 4. If the meter reading is less than 15 V dc, the battery is weak and should be replaced.

Step 5. Loosen the four captive screws in the back housing panel and separate the housing from the front panel and chassis.

Step 6. Loosen the captive screw holding the battery mounting clamp to the housing.

Step 7. Remove the battery mounting clamp and battery from the housing.

Step 8. Disconnect the terminal leads from the old battery and connect them to the fresh battery (SLN6212A Battery Kit or Part No. 60B82457B01). OBSERVE POLARITY; red leads to positive (+) terminal, black lead to negative (-) terminal.

Step 9. Clamp battery and re-assemble housing.

NOTE

If the audio oscillator is to be operated only from the ac line voltage, it is suggested that the battery be removed to prevent corrosion due to possible battery leakage.

9. CALIBRATION

9.1 GENERAL

Accuracy of the S1067B Audio Oscillator is maintained by periodic calibrations performed by qualified personnel and adequate test facilities. If desired, the unit may be returned to the factory for this service, or contact your local area Motorola parts office.

The calibration procedure outlined herein is intended for general maintenance only. If any electrical component changes are made, such as the replacement of transistors, trimmer capacitors, etc., it is suggested that the instrument be returned to the factory for calibration, or to your local area Motorola parts office.

9.2 FREQUENCY DIAL CALIBRATION

Step 1. Loosen the four captive screws in the back housing panel and separate the housing from the front panel and chassis.

Step 2. Connect the oscillator output to a 150-ohm resistive load and to a Motorola Model S-1344 Frequency Counter, or equivalent.

Step 3. With the audio oscillator operating from 117 V ac, set the AMPLITUDE control to maximum and the RANGE switch in the x10 LINE position.

Step 4. Loosen the two set-screws on the FREQUENCY dial knob.

Step 5. Position the chassis to access the ceramic coupler for the air-dielectric tuning capacitor shaft. Using the finger tips, turn the ceramic coupler until the capacitor plates are fully meshed (maximum capacitance).

Step 6. Slowly turn the ceramic coupler counterclockwise approximately 18° to obtain a frequency counter reading of 200 Hz using the 1 second count (1 Hz resolution).

NOTE

A ± one count reading (1 Hz resolution) is allowed since counter accuracy is normally ± one count.

Step 7. Hold the ceramic coupler while gently rotating the frequency dial until the 20 mark is aligned with the FREQUENCY indicator index mark. Lightly tighten one of the frequency dial set screws.

Step 8. Turn the frequency dial counterclockwise until the 200 mark on the dial is aligned with the FREQUENCY index mark.

Step 9. With an insulated tuning tool, adjust 3-12 uuF trimmer capacitor C7 on the circuit board for a 2000 Hz reading on the frequency counter.

Step 10. With the frequency dial in the same position as in Step 8, store the RANGE switch in the x1K LINE position. Tilt the audio oscillator chassis backwards. With an insulated tuning tool, adjust trimmer capacitor C1 at the bottom of the RANGE switch to obtain a frequency counter reading of 199,800-200,200 Hz using the 1 second count.

Step 11. Place the RANGE switch in the x10 LINE position. Replace the oscillator housing using only the captive screw nearest the battery to hold it in place. This screw provides the electrical connection required between the housing and the audio oscillator circuits.

Step 12. Align the 20 mark on the frequency dial with the FREQUENCY index mark. Adjust the frequency dial fine adjustment control to obtain a frequency counter reading of 2000 using the 10 second count. At this setting the frequency will be 200 Hz.

If the frequency counter is not equipped with a 10 second count, the 1 second count may be used. In this instance the counter will read 200 Hz. The 200 Hz calibration error using the 10 second count will be 0.05% plus the counter error. The calibration error using the 1 second count will be 0.5% plus the counter error.

Step 13. If the 20 mark on the frequency dial is not in line with the FREQUENCY index mark, loosen the set screw in the knob and turn the dial until these marks are aligned. Tighten both set screws.

Step 14. If the frequency changes in the performance of Step 13, repeat Steps 12 and 13.

Step 15. Align the 200 mark on the frequency dial with the FREQUENCY index mark. Using the 1 second count, the frequency counter reading should be approximately 2000 Hz. If this reading is not within the tolerance limits of the counter (± one count) separate the housing from the audio oscillator. Adjust 3-12 uuF trimmer capacitor C7 on the circuit board to obtain the 2000 Hz (± one count) counter reading *after* the housing is replaced.

There is a slight difference in frequency between the "housing off" and "housing on" condition. The frequency counter reading with the housing off is approximately 1% higher than with the housing on. Therefore, when adjusting trimmer capacitor C7, adjust for a counter reading of 2020 Hz. If, after replacing the housing the counter does not read 2000 Hz ± one count, repeat the trimmer capacitor adjustment procedure compensating for the "housing off-housing on" frequency difference, maintaining the 200 mark frequency dial setting. It may be necessary to repeat this procedure several times to obtain the proper setting.

Step 16. Place the RANGE switch in the x1K LINE position. Using the 0.1 second count, the frequency counter should read 19900-20100. If the counter reads less than 19900 or more than 20100, remove the housing and readjust trimmer capacitor C1 on the RANGE switch. Use the same frequency compensation procedure outlined in Step 15.

Step 17. Replace and tighten the remaining three housing screws.

10. TROUBLESHOOTING

To properly troubleshoot the Model S1067B Audio Oscillator, the following Motorola test equipment (or equivalent) is required.

-- S1063B DC Multimeter
-- S1053C AC Voltmeter
-- D61 Oscilloscope

Table 2 is provided to aid the serviceman in locating troubles quickly. It indicates symptoms and possible causes. To locate components, refer to the COMPONENT LOCATION DETAILS in the rear of these instructions.

Table 2. Symptoms and Possible Causes

SYMPTOM	POSSIBLE CAUSE
No Output, Low Output or Intermittent Output	Dead or Weak Battery
Distorted or Excessive Output Voltage*	Open Negative Feedback Loop

* As observed on an oscilloscope, the output voltage waveform should be a pure sine wave.

The 1 kHz distortion analyzer can be checked by feeding the oscillator output into the 1 kHz distortion analyzer input, connecting the ac voltmeter to the distortion analyzer output and performing Steps 9 through 12 in paragraph 6.2. Check the distortion analyzer at audio oscillator output amplitude, where distortion is maximum.

It is suggested that troubleshooting be limited to voltage readings rather than resistance readings. However, if it becomes necessary to take resistance

measurements, use an ohmmeter that has a probe voltage not greater than 200 millivolts. This will prevent damage to transistors, diodes, thermistors, etc.

CAUTION

Do not replace any component with power applied. Disconnect the battery and the ac line cord.

For optimum performance when replacing transistors, diodes, capacitors or the thermistor, use only Motorola replacement parts. It is highly recommended however, that when these components, or any other electrical components other than carbon resistors are replaced, the audio oscillator be returned to the factory for recalibration.

PARTS LIST

SLN6211A and B Audio Oscillator Kit EPD-15282-D

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		CAPACITOR, variable:
C1, 7	20K848635	3-12 uuf; NP0
C6	19C83731D01	2 section; consist of:
C6A		15-527.5 uuf; 350 v
C6B		15-527.5 uuf; 350 v
		CAPACITOR, fixed:
C2, 4, 15	23C82077C01	100 uf +150-10%; 35 v
C3, 5	21B82428B01	.02 uf +60-40%; 100 v
C4	23C82077C14	300 uf +150-10%; 40 v
C8	21K859937	24 uuf ±5%; 500 v
C9		(factory selected)
C10	23D82601A21	100 uf +100-0%; 10 v
C11	23D82601A05	50 uf +150-10%; 25 v
C12, 14	23C82077C05	300 uf +150-10%; 20 v
C13	23D82601A26	25 uf +150-10%; 20 v
C17	23D82601A29	60 uf +150-10%; 50 v
C18, 20	8D82905G06	0.47 uf ±10%; 50 v
C19, 21	8D82905G03	.047 uf ±10%; 50 v
C22	21K840046	100 pF ±10%; 500 v
		SEMICONDUCTOR DEVICE, diode: (NOTE)
CR1, 2, 3, 4	48C82392B03	silicon
CR5, 6	48C82466H03	silicon
		CONNECTOR, receptacle:
J1	9B82137E01	female: 3 contact
		REACTOR:
L1	24V80902A88	tunable
		TRANSISTOR: (NOTE)
Q1	48R869429	F.E.T.: type M9429
Q2, 3	48R869430	N-P-N; type M9430
Q4, 6	48K869431	N-P-N; type M9431
Q5, 7	48R869432	P-N-P; type M9432
		RESISTOR, fixed: ±5%; 1/2 w; unl stated
R1, 10	6D82475B67	15.6 meg ±1%
R2, 9	6D82672B46	154K ±1%
R3, 12	6D82475B66	1.54 meg ±1%
R4, 11	6D82672B45	15.4K ±1%
R5, 24, 25, 28, 29	6S114018	10
R6, 20	6S5556	10K
R7	6S2003	3.3K
R8, 27	6S2024	3.9K
R13	6S5772	47K
R14	6S6480	22K
R15	18C82567D01	variable: 20K ±20%; 1/8 w
R16	6S400056	47
R17	6S400424	68
R18	18C82676B01	variable: 100 ±20%; 0.2 w
R19, 22	6S3924	4.7K
R21	6S5726	15K
R23	6S400812	470
R26	18C82810C06	1K ±30%; incl. S2
R30	6S6031	100K
R31	6S6408	100
R32, 34	18D82515B01	1K
R33	6S400459	1.5K
		THERMISTOR:
RT1	6B83728D01	1.2K ±20% @ 25°C
		SWITCH,
S1	40C83730D01	rotary: 3 section; special type
S2		(spst; p/o R26)
S3	40C82148F01	slide; dpdt
		TEST POINT:
TP1	9K833983	single contact; RED

NON-REFERENCED ITEMS		
	13-84602F02	ESCUTCHEON
	36-84675F05	KNOB; for FREQUENCY control
	4-7683	WASHER, internal; #4; 3 used
	43-82377B52	SPACER; 3 used
	36-84675F02	KNOB; 3 used
	3-3867	SCREW, set: #6-32 x 5/32; 3 used

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION

SKN6010A Power Cable Kit EPD-15283-O

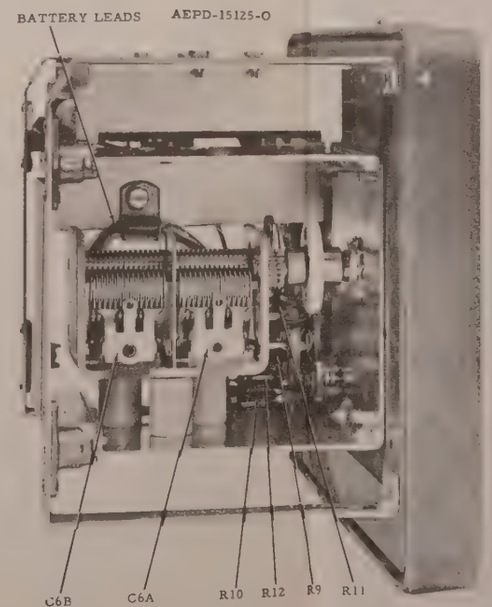
P1		CONNECTOR, plug: male;
P2	28C82138E01	3 contact (p/o W1)
		3 contact
T1		TRANSFORMER, power:
		117 v; 50-400 cps (p/o W1)
W1	SKN6010A	CABLE ASSEMBLY, power: incl. P1, P2, T1 and CABLE; 2 conductor; shielded; 6 ft. long

SLN6212A Battery Kit EPD-15284-O

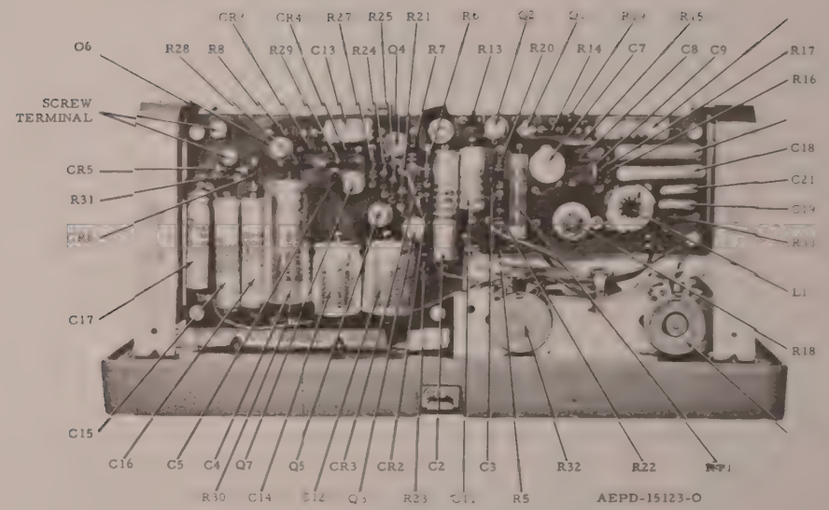
BT1	60B82457B01	BATTERY, dry; 22.5 volt #763

NOTE:

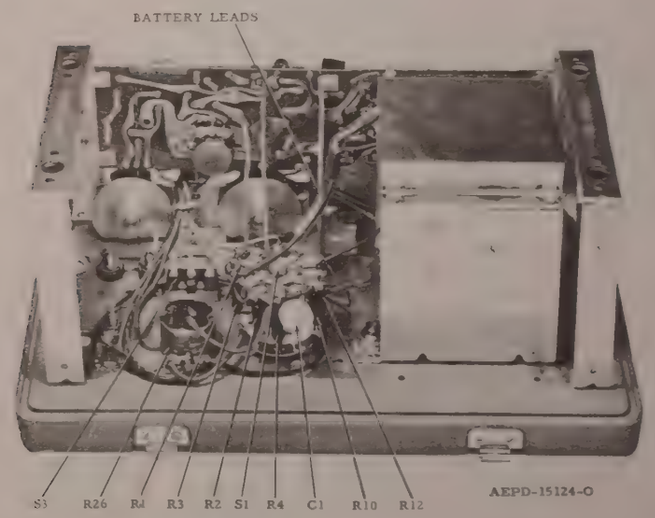
Replacement diodes and transistors must be ordered by Motorola part number only for optimum performance.



Left-End View



Top View



Bottom View

S1067A and B Audio Oscillator
Parts Location Details & Schematic Diagram
Motorola No. PEPD-15269-A
11/22/76-UP

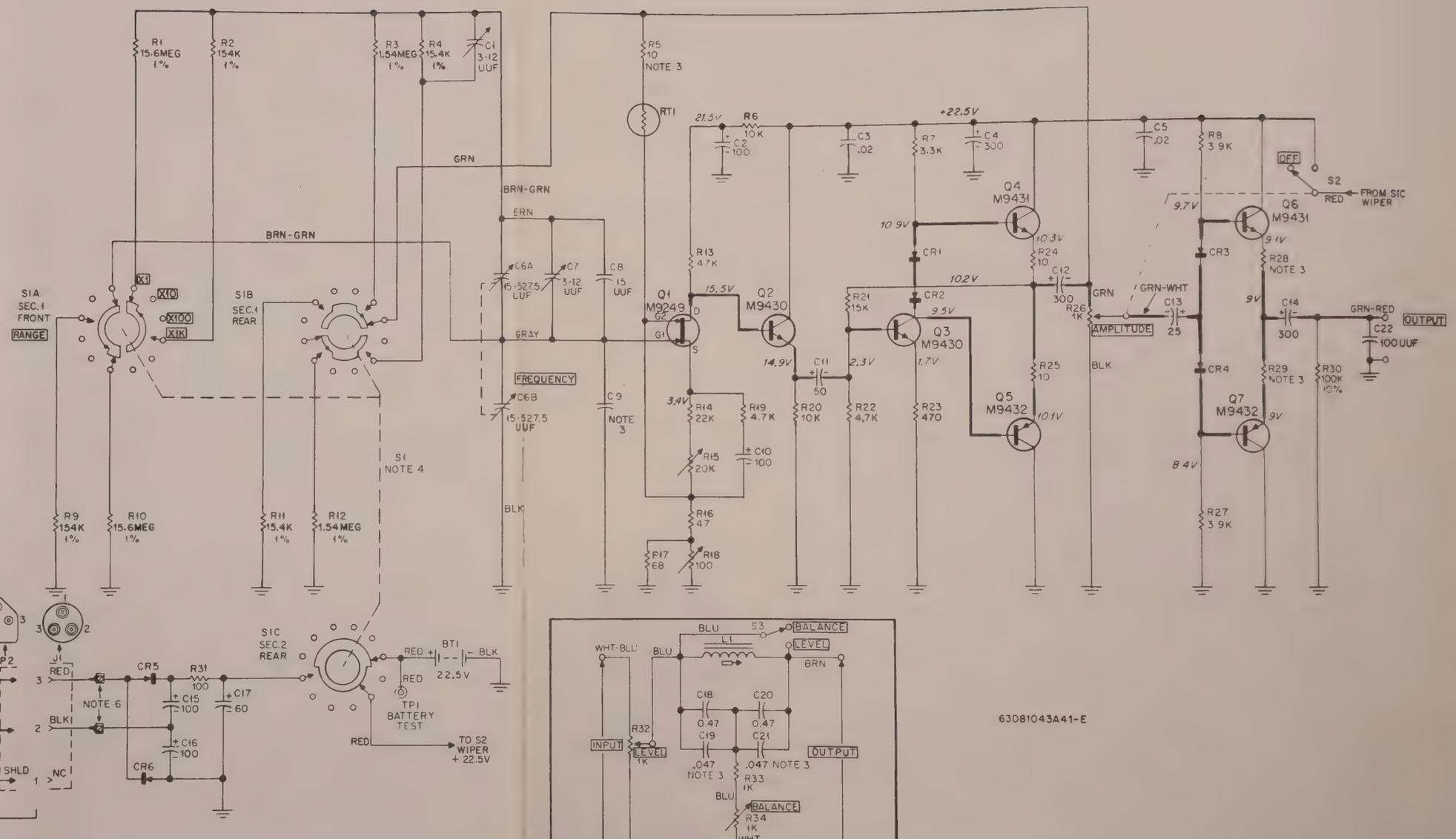
TYPICAL DC CIRCUIT VOLTAGES (NOTE 2)

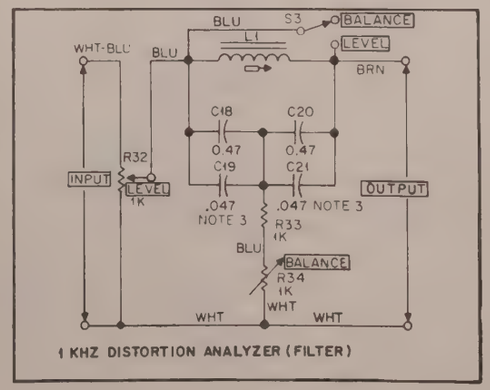
TRANSISTOR	EMITTER	BASE	COLLECTOR
Q1	3.4 (SOURCE)	0 (GATE 1 OR 2)	15.5 (DRAIN)
Q2	14.9	15.5	
Q3	1.7	2.3	9.5
Q4	10.3	10.9	22.5
Q5	10.1	9.5	0
Q6	9.1	9.7	22.5
Q7	9	8.4	0

NOTES

1. UNLESS OTHERWISE INDICATED ALL CAPACITOR VALUES ARE IN MICROFARADS AND RESISTOR VALUES ARE IN OHMS.
2. VOLTAGE READINGS ARE TYPICAL VALUES MEASURED WITH A MOTOROLA DC MULTIMETER (11 MEGOHM INPUT RESISTANCE) WITH RESPECT TO CHASSIS AND USING 22-1/2 VOLT INTERNAL BATTERY.
3. COMPONENT VALUE SELECTED AT FACTORY, IF COMPONENT IS USED. VALUES SHOWN ARE TYPICAL.
4. RANGE SWITCH IS SHOWN IN x1 POSITION AND IN BATT OPERATION. DOTS SHOWN ON ROTORS ARE THROUGH CONNECTIONS FROM FRONT TO REAR ROTORS.
5. EXTERNAL GROUND MUST BE USED FOR AC OPERATION.
6. RED OR BLACK LEAD MAY BE CONNECTED TO EITHER SCREW TERMINAL

NEPD-15291-A





63081043A41-E

REVISIONS 63D81043A41-E

CHASSIS AND SUFFIX NO.	REF. SYMBOL	CHANGE	LOCATION
SLN6211A	R19	WAS 470 OHM	OSCILLATOR AMPLIFIER
SLN6211A-1	R19	WAS 6R2028; 2.2K	Q1-S
	S3	WAS 40A11589, SPST	L1 1KC DISTORTION ANALYZER
SLN6211A-2	C8	WAS 21K859937; 24 uuf ±5%, 500 v	Q1 - G1
SLN6211A-3	R8,	WAS 6S2001; 6.8K	Q6 BASE
	R27		Q7 BASE
	R16	WAS 6S11018, 10	Q1 BASE
SLN6211A-3	C22	ADDED 100 pF	Q6, Q7 EMITTER
SLN6211B		ADDED NEW MODEL	

AUDIO OSCILLATOR
20-200 kHz

68P81043A40-D

MP MASTER
MA36331